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A FRAMEWORK FOR ANALYZING THE IMPACTS ON AGRICULTURE OF GOVERNMENT  
POLICIES LEADING TO INDUSTRIAL DEVELOPMENT IN NON-URBAN AREAS

Patty J. Skelding and Lawrence W. Libby

ABSTRACT

Policy-makers need analytical frameworks which aid in evaluating the distribution of impacts of their decisions. The first section of this paper describes an Environment - Behavior - Impact framework for analyzing the impacts on agriculture of government policy changes which favor development in non-urban areas. An illustration of the framework using a hypothetical example follows, and the final section is a discussion of the applicability of empirical methods to the framework.

INTRODUCTION

One of the highest priorities for residents and government officials in the Northeastern United States is to attract industry to the region to help revive its declining economy. While economic growth is important to the region, there is also concern for the viability of agriculture and the quality of the natural environment in the region. These two goals may be in conflict in some cases; that is, industry and agriculture may be interrelated in such a way that the development of one sector may have negative impacts on the other. It is this potential tradeoff between agriculture and industry which provides the rationale for the framework to be developed in this paper.

Neoclassical economists have widely advocated the economic efficiency rule as a criterion of "goodness." Recognizing the fact that purely Pareto-optimal situations rarely, if ever, occur in our political economy, Hicks and Kaldor devised a criterion which has been used to justify decisions which benefit some individuals at the expense of others. We are contending that there are at least two aspects of efficiency, whether in its pure or diluted form, which make it an unwise choice as a decision rule in regional land use problems. The first aspect is that the "social optimum" does not necessarily represent a "best" or even a "good" solution from the individual standpoint. There is no logical reason to believe that those who bear the costs of a decision made via the Hicks-Kaldor criterion will label that decision as optimal, or even an improvement. This is not particularly important to private firm decision makers since they generally do not have to worry about costs imposed on others. However, industrial development in non-urban regions requires the cooperation of local government officials and their set of alternative

land use controls. Government officials face the pressure and loss of votes of those who lose from their decisions; therefore, these officials are concerned with the distribution of the impacts of their decisions.

The second problem with efficiency is that it is a normative concept. It tells us that a decision is "good" based on a given structure of property rights and distribution of resources. The decisions advocated as best are those that can be accomplished within the status quo institutional structure. The Hicks-Kaldor criterion is even more biased in that it enables us to choose between individual gainers and losers. For more on these aspects of efficiency, see the articles by Libby and McDowell in previous issues of this Journal.

Most frameworks and techniques for analyzing land use issues are based on the concept of economic efficiency. We contend that a framework which provides information on the distribution of impacts among different groups of alternative land use policies would be far more useful to policy makers. The first section of this paper describes an Environment-Behavior-Impact framework for analyzing the impacts on agriculture (one group of participants in a region) of an institutional structure conducive to industrial development in a non-urban region. The second section illustrates the workings of the framework with a hypothetical example. The final section is a brief discussion of the applicability of empirical analysis to the framework. Our overriding objective is to show that positive economic analysis can be useful to policy makers and other participants in the political battles fought over every institutional change.

CONSTRUCTION OF THE FRAMEWORK

We have chosen to base our framework on the premise that individual behavior is shaped by the environment within which individuals operate. A change in the environment of a system will change the behavior of individuals in the system. The new behavior in turn has impacts on some or all of the participants in the system (Schmid, 1978 and Shaffer). Our objective is to describe the impacts on agriculture of institutional changes conducive to industrial development. A model such as the environment-behavior-impact (E-B-I) framework enables us to identify the intermediate adjustments that occur between the implementation of an institutional change and the point when we choose to stop measuring the impacts on agriculture.<sup>1</sup> Knowledge of these adjustments should be useful in understanding the workings of the system under analysis and other similar systems,

Patty J. Skelding is Graduate Research Assistant and Lawrence W. Libby is Professor, Department of Agricultural Economics, Michigan State University.

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<sup>1</sup> This model is evolutionary. The institutional change will continue to influence behavior and impact performance long after we cease measurement (Shaffer).



predicting the long range impacts on agriculture, and suggesting remedies to potential negative impacts.

#### Definition of Environmental Variables

The components of the environment in which individuals operate may be viewed as independent variables at a given moment, but they are really dynamic explanatory variables which are affected by their own and each other's impacts on the system. Although the definition of key environmental variables may change from case to case, we feel that the following components of the regional environment are important to agriculture in all cases.

1. Institutions. The entire set of formal and informal, private and public rules which affect behavior and decision making is contained in this variable. The participants in the region try to influence the institutional structure since it determines who has access to resources (Schmid, 1978). Changes in land use rules may enable developers to use nonurban land. On the other hand, the Northeastern state and local governments have been exceptionally innovative in developing and using alternative institutions to protect agricultural land in growing industrial areas. Examples of these institutions include agricultural districts, exclusive agricultural zoning, and transferable development rights (Conklin, et al.).

2. Factor Markets. Input markets play a determining role in the costs and amount of production. These markets are, of course, very complex, but important aspects which may be measurable include the types of factors available, aggregate regional supply of each factor, aggregate regional demand for each factor, and the distribution of aggregate supply and demand among the various suppliers and producers in the region. The types of inputs required by farmers include product and factor transportation facilities; production inputs such as equipment, land, feed, chemicals, livestock, and labor; credit facilities such as private banks, Production Credit Associations, the Federal Land Bank, the Farmers' Home Administration, and insurance companies; technical agencies such as the Cooperative Extension Service and Soil Conservation Service; public services such as irrigation and schools; and private services including health care and retail establishments. Manufacturing firms may compete with agriculture for some of these inputs.

3. Product Markets. Product markets determine the revenue side of income and thus impact agriculture. However, we are assuming that changes in output in regions of the size that we would study do not affect product markets. Farmers and industrialists in a region are price-takers, with price being determined exogenously in a much larger regional or national market.

4. Production Technologies. Knowledge of the underlying technology in the production of agricultural and manufactured commodities enables us to determine the substitutability of inputs and outputs with changes in relative factor prices (assuming constant output prices).

5. Attitudes of the Different Participants Concerning Agriculture. The perceptions and attitudes of the participants in the regional political economy towards the viability and importance of agriculture in the region will be affected by industry in the region. Depending on their attitudes, the participants may exit the region, push for changes in government institutions, or be indifferent if they perceive that agriculture is declining in the region. This variable is extremely important in determining behavior but, unfortunately, is also difficult to measure.

6. Demographic Characteristics. This variable contains aspects of the rural population such as density and diversity. The aesthetic appeal and production costs of an agricultural lifestyle may be affected by these characteristics.

#### Behavior

Dealing with the behavioral aspects of the model is extremely difficult for several reasons. First, we lack the ability to predict human responses to environmental stimuli with complete accuracy, which inhibits both qualitative and quantitative analyses. Second, our need to simplify and categorize behavioral processes to avoid having to observe each affected individual requires the aggregation of individuals into groups of participants with similar goals. This aggregation is arbitrary. Third, there tends to be no disaggregation of participants at all in many empirical studies. This makes sense since we are unable to quantify individual reactions easily. Even if we cannot measure reactions for several different groups we can at least discuss how different groups of people will most likely react to a change in environment and use this to conceptualize our problems logically in conjunction with economic theories. A classification of individuals into several groups (instead of one group) also gives us a basis for a discussion of the distribution of impacts of an environmental change.

In an attempt to simplify our thinking on the behavioral responses of participants to a new industry in the region, we have classified individuals into groups according to their socioeconomic goals.

The groups that we feel are important to isolate are farmers, suppliers of factors of production, industrialists, non-farm residents and local government officials. It is unrealistic to assume that participants have unitary goals subject to dollar constraints, so we have attempted to expand upon that assumption while still keeping the qualitative analysis simple.

Farmers can be assumed to be profit maximizers; however, they have constraints other than costs. They may desire to maintain their agricultural lifestyles or they may be occupationally immobile so that they forego opportunities to increase net incomes in other occupations.

Suppliers of factors of production can also be considered profit maximizers, with constraints of costs and possibly immobility. Likewise, industrialists will be considered profit maximizers.



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Non-farm residents are income maximizers with constraints of the desire for a particular quality of living environment and a certain degree of immobility.

The above participants are assumed to have an additional goal and an additional constraint which diverge from neoclassical economic theory. All are operating under a constraint of uncertainty, which means that their attitudes and perceptions will be important in influencing their behavior as well as the other aspects of structure which actually affect their incomes. An additional goal of each of the above groups is that its members try to influence government to adopt rules which are to their benefit. All groups will not always (or often) agree on which rules are best.

Finally, in this context we shall assume local government officials to be welfare maximizers for their jurisdictions under the constraints of politically feasible costs and their own personal welfare maximization. For example, if a government official is a vote maximizer, s/he will attempt to attract those activities to the area which seem to please the most (or the most influential) constituents (Bartlett). Because officials have different ways of maximizing their personal welfare, and because they operate under uncertainty, they will neither always agree nor always attract activities which are efficient from "society's" standpoint. The role of attracting industry (or some other activity) includes the facilitation of orderly development via the provision of public services which benefit the industry and the coordination of any additional development attracted to the area with government institutions such as zoning.

This classification of participants is very much a simplification of the real world. However, it tells us more than an analysis with no disaggregation of the participants.

### Impacts

The impact of an environmental change is a dependent variable, yet it is also explanatory in that it explains subsequent environmental changes. Common impact variables in broader economic studies (often described as societal goals) include economic efficiency, equity, and economic growth (Schmid, 1978 and Shaffer). In this particular study we have chosen to focus on the impacts on agriculture associated with environmental changes which result in and result from the new location of non-farm industrial development.

Describing the impact of an environmental change involves much more than the choice of the variable—it also requires the choice of measures of that variable (Shaffer). There are hundreds of potential measures of a variable as broadly defined as "the impacts on agriculture." Schmid (1976) points out that we often measure performance in terms of the inputs, outputs, or impacts of a particular public program. In this case, the program is the decision to change the institutional structure in a rural area in a way which will attract industrial development. Inputs to this program may include governmental efforts to

attract industry and the expenditures for public services to support development. The use of inputs is an incomplete and difficult method of tracing the impacts of the program on farmers.

Outputs represent changes in the environment which occur as a result of the program. Changes in supply of and demand for agricultural inputs, increased density and diversity of the regional population, changes in the market values of farm property (such as land), and changes in attitudes towards agriculture are but a few of the potential outputs of the program which may relate to agriculture. But the measurement of outputs does not provide information on the impacts on agriculture.

The impacts of the program on agriculture ultimately depend upon the reactions of the participants to the outputs of the program. Figure 1 shows possible impacts which correspond with each of the outputs listed in the previous paragraph.

We are not realistically capable of empirically measuring all of the different impacts on farmers. Measures such as the region's share of a larger area's agricultural production costs or the ratio of the region's agricultural production to total regional production may be useful proxies of the impacts suggested in Figure 1. Figure 2 summarizes the framework.

### APPLICATION OF THE FRAMEWORK TO A HYPOTHETICAL EXAMPLE

The objective of this section of the paper is to apply the framework developed in the previous section to a hypothetical case of a change in land use policy in a non-urban area. Figure 3 is an attempt to express sequentially behavioral responses to environmental changes caused by the new policy and the impacts of these responses on agriculture.

The following conditions hold for our hypothetical example: the region of analysis is an economy based on agriculture and there are no industries in the region; unemployment of capital in the region is high and input suppliers are pressuring the government to recruit an industry to the region; and there are limited quantities of all inputs needed by industry and agriculture.

The initial environmental change occurs when government responds to the pressure by the suppliers of inputs and changes existing institutions in order to make the area more hospitable to a particular industry. The government changes zoning regulations and offers a substantial tax break to the industry which it is trying to attract. The strategy produces the desired change in behavior—a paper industry decides to move to the region.

When the industry locates, a further environmental change occurs. The new industry requires land, raw materials, labor, capital, transportation facilities, public services different from those already provided for agriculture, private services such as residential development for employees who migrate into the region, and a receptacle for waste materials. The



Figure 1: Outputs and Impacts

<u>Outputs</u>	<u>Possible Impacts</u>
Changes in Supply of and Demand for Agricultural Inputs	Increased costs to farmers. Reduction in farm output. Exit of marginal farmers. If demand for inputs falls enough, input suppliers may exit. Eventually there may be too few inputs in the regions to support any agriculture.
Increase in Density and Diversity of Regional Population	Decrease in aesthetic value of agricultural lifestyle. Change in social acceptability of farm practices leading to increases in civil suits against farmers. Increase in rural crimes such as theft of farm equipment.
Increased Market Value of Land	Windfall gains to farmers who sell their land. Higher taxes for farmers who don't sell. Higher opportunity cost to remain in farming.
Changes in Attitudes towards Farming	Pressures on government result in changes in institutions which may benefit or hurt farmers.

Figure 2: Summary of the Framework

<u>Environment</u>	<u>Behavior</u>	<u>Impact</u>
1. Institutions Private and government rules affecting economic activity and land-use in the region.	1. Input Suppliers—profit maximizers and government influencers a. inputs for agriculture only b. inputs for industry only c. inputs for agriculture and industry	1. The ratio of agricultural production costs in the region to agricultural production costs in the state.
2. Factor Markets a. types of inputs available b. aggregate regional demand for each input c. aggregate regional supply of each input d. relative distributions of supply and demand among suppliers and producers in a region	2. Farmers—profit maximizers and government influencers 3. Industrialists—profit maximizers and government influencers	2. The ratio of agricultural production to total production in the region.  (See Figure 1)
3. Product Markets Considered exogenous to the region	4. Non-farm Residents—income maximizers and government influencers	
4. Production Technology Potential mixes of inputs and outputs to maximize profits at different price structures for inputs (output prices are constant)	5. Government Officials—regional welfare maximizers  All of the above participants operate under various constraints.	
5. Attitudes of participants regarding the viability and importance of agriculture in the region		
6. Demographic Characteristics—Density and diversity of regional population		



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Figure 3: A Hypothetical Example

<u>Changes in Environment</u>	<u>Changes in Behavior</u>	<u>Impact</u>
Change in Institutions conducive to industry.	Industry enters region.	
Increase in demand for industrial (and thus some agricultural) inputs.	Prices for inputs bid up in immediate run.	Increased costs to farmers.
Increase in density and diversity of regional population.	Suppliers of mobile inputs migrate into region.	Downward adjustments in costs.
	Increases in rural crime, suits against farmers, pressure on government and decrease in aesthetic appeal of region to farmers.	Increased costs to farmers.
Increase in demand for agricultural land.	Marginal farmers exit, remaining farmers substitute machinery for labor and increase farm size.	Net increase in farm production.
	Land prices bid up. Some farmers sell.	Increased costs to farmers.
	Some labor enters region hoping to combine non-farm and part-time farm incomes and to enjoy rural lifestyle.	
Increased demand for agricultural inputs since new farmers are engaging in land-intensive farming (fruits and vegetables). Increased density and diversity of population.	Prices for inputs bid up.	Increased costs to farmers.
	Rural crime, civil suits, etc.	
Decrease in supply of agricultural inputs.	Marginal farmers exit. Others decrease output since land prices are higher. Marginal agricultural input suppliers exit because prices are bid down.	Decreased farm productivity. Decreased costs.
	Full-time farmers will not enter region for a variety of reasons. (Shrinking supply of inputs, population density and diversity, higher land prices, etc.).	
Attitudes towards agriculture change.	Input suppliers for agriculture migrate to regions where agriculture is more viable.	Increased costs. Critical point approaches where agriculture can no longer be sustained by support system.
Change in institutions conducive to agriculture.	Pressure on government to protect agriculture. Response to pressure.	



environmental change occurs when aggregate regional demand for all of these inputs increases. In response to this change, farmers and industrialists bid up the prices of each input until there is no longer excess demand. The industry has considered the effect that its demand has on input prices prior to moving into the area, so industrial operations continue. The impact on farmers, who face constant output prices, is higher costs.

In the short run, suppliers of mobile inputs migrate into the region to obtain higher prices. This results in a reduction in the input costs to farmers, but it also causes an increase in the density and diversity of the regional population. With this demographic change may come increases in rural crime, more civil suits against farmers for "annoying" agricultural practices, new pressures on government and a decline in the aesthetic appeal of the region to farmers. All of this results in increased social and monetary costs to farmers.

Also in the short run, marginal farmers exit in response to higher costs. At this point in time, the remaining farmers substitute machinery and other capital for labor inputs and also increase the size of their farms in an attempt to find the input and product mix which maximizes profits given the new input prices. Overall, there is a net increase in farm production. There is also a net increase in the demand for agricultural land. Land prices are bid up, and some farmers sell their land to capture windfall gains. The higher prices increase the opportunity cost of continued farming since the gains in selling land are higher and higher assessed values result in larger tax burdens. This makes it more difficult for land-extensive farmers to enter the region.

Meanwhile, some labor suppliers enter the region hoping to work for the industry and farm on a part time basis. These new part time farmers begin land-intensive enterprises (e.g., fruits and vegetables) since the price of land is fairly high relative to other inputs. The demographic characteristics of the region change further. Responses to the increased demand for agricultural inputs and the demographic changes include the bidding up of input prices, increases in rural crime, and decreases in the aesthetic value of the area to farmers. The impact is increased costs to farmers.

In response, marginal farmers exit, and the remaining farmers decrease output since land prices are higher. Prices for inputs are bid down, and the marginal agricultural input suppliers exit. The resultant impacts are decreased farm productivity and decreased costs to farmers.

However, full time farmers will no longer enter the region in response to the decrease in costs. They perceive agriculture as being no longer viable in the region due to shrinking input supplies, increased population density and diversity, and higher land prices. Input suppliers begin a large scale migration to regions where agriculture is more viable. This increases costs to the remaining farmers in the region, and the region is threatened with reaching a critical

point where full time commercial agriculture can no longer be sustained by the region's support system.

At this point, attitudes towards agriculture change and there is intensified pressure on government to design institutions to protect agriculture. The government responds to the pressure by implementing institutions which favor agriculture, and a new round of impacts begins.

It should be noted that in this case, we assumed no agglomeration economies for industry and no land speculation. Any non-agricultural activities attracted to the area by the new industry may very well have magnified the impacts. Also, this analysis was only one possible scenario of many; industrial development does not always have negative impacts on agriculture.

#### POSSIBLE EMPIRICAL STUDY

Attempts to apply empirical methods to this framework are very much in preliminary stages. We are planning to apply the model, or its measurable portions, to the recent location of a General Motors plant in Three Rivers, Michigan. The site represents a unique opportunity to study the impacts of industry on agriculture because the GM plant is the only major industry in an area which is otherwise agricultural. Yet the GM plant is probably large enough to have some kind of an impact on agriculture in the region.

Methodologies being considered include: 1) Comparing St. Joseph's county with nearby Cass county (if they are similar enough) and using regression analysis to explain one of the agriculture impact indicators in each county, assuming that the major difference between the two counties is that St. Joseph's has a GM plant (and institutions conducive to development), while Cass does not. 2) Simulation of changes in St. Joseph's County over time, say from 1970 to 1985.

It is important to note briefly that the construction of the framework and of an empirical model require value judgments by the analyst. The choice of key environmental variables, the aggregation of individuals into behavioral groups, and the choice of impact variables and measures are all decisions made to reduce the complexity of the world to manageable levels. These choices would have to be simplified still further for empirical analysis. In addition, measurement requires the aggregation of space into a region and the aggregation of time, both of which involve data loss.<sup>2</sup> Analysts must make these value judgments explicitly, so that critics can fault our view of the world rather than our analysis.

#### CONCLUSIONS

The complex real-world problem of determining the impacts on agriculture of institutions which attract industrial development to non-urban areas has been simplified into a conceptual framework. The Environment-Behavior-Impact framework enables us to examine the intermediate

<sup>2</sup> Thanks to Daniel E. Chappelle for this point.



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adjustments and distribution of impacts resulting from an environmental change. We applied the framework to a simple hypothetical case to give an example of the interdependence between institutional structure, industrial location decisions, and the agricultural sector of a regional economy.

The next step is empirical testing. Such testing based on currently available techniques would require further simplification of the problem so that the variables could be measured numerically. Unfortunately, this may result in compromising some of the strong points of our framework. There is a need to develop empirical methods which allow us to examine intermediate impacts, behavioral responses and the distribution of impacts more carefully.

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